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James A. K. Miyamoto, P.E.
Deputy Operations Officer
Naval Facilities Engineering Command, Hawaii
400 Marshall Road
Joint Base Pearl Harbor Hickam, HI 96860

Re: Approval in part of Red Hill AOC SOW Deliverable under Sections 6 & 7 - Monitoring Well Installation Work Plan

Dear Mr. Miyamoto:

The U.S. Environmental Protection Agency ("EPA") and Hawaii Department of Health ("DOH"), collectively the "Regulatory Agencies", have reviewed the *Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility* ("MWIWP") submitted by the U.S. Navy ("Navy") and Defense Logistics Agency ("DLA") on April 26, 2016. The Regulatory Agencies are approving the MWIWP in part, pursuant to AOC Sections 7(b)(a) and 7(b)(b) and under the conditions as detailed below. The attachment to this letter provides details on those portions of the MWIWP that are disapproved. The Navy is required to resubmit the MWIWP with corrections within 30 days of their receipt of this letter as per AOC Section 7(b).

The Regulatory Agencies approve Sections 3, Monitoring Well Network Expansion Design and Rationale, and Section 4, Field Project Implementation, of the MWIWP subject to the Navy's addressing the following items;

1. The MWIWP includes the collection of soil samples for analysis. Section 2.2 of the MWIWP states that the secondary objective of the MWIWP is to evaluate the nature of petroleum product and constituent chemicals in the soil, if present in the vadose and saturated zones underlying and downgradient of the tanks. It further states that the scope of the sampling and analysis program in the MWIWP is limited to the collection of subsurface **soil** and which will only be conducted if soil is encountered at depths below the bottom of the tanks or if contaminated soil is encountered. The Regulatory Agencies require the Navy and DLA to broaden the scope of their sampling and analysis to include any material that is coarse grained or smaller in size, e.g. clay, sands, fine gravels, ash, cinder, and clinker zone sand. Any contaminated material of this type will be sampled and analyzed if it is encountered at depths below the bottom of the tanks or if contaminated materials of this type are encountered while drilling. The collection of samples is referenced in Sections 3.1, 3.2.1, 3.3, 4.3.1, 4.3.2, 4.3.4, 4.3.9 and 4.5 of the MWIWP.

2. The MWIWP is unclear on how often the drilling operator and site geologist will check for perched water zones. Sections 3 and 4 address the possibility of encountering perched zones and

what steps the Navy and DLA will take to prevent perched water from migrating to the basal aquifer. However in Sections 3.2.2, 3.2.3, 4.3.1, and 4.3.2 the MWIWP states "To facilitate the identification of perched groundwater, water levels in the borehole, if present, will be measured at the beginning and end of each work day". The Regulatory Agencies require, and the MWIWP seems to imply, more frequent checks for perched water zones while drilling. The Navy and DLA need to provide more specific information on how and at what frequency they will check for perched water zones while drilling.

3. Section 3.5 of the MWIWP states that the monitoring wells and other pertinent site features will be surveyed and located with respect to an established control point in accordance with NAVFAC procedures. The Regulatory Agencies want to emphasize the importance of accurately surveying the top of casing for these new monitoring locations as well as the existing monitoring locations. The groundwater flow gradient is a regional problem involving the possibility of groundwater flow from the Honolulu Aquifer to the Pearl Harbor Aquifer. It is important that top of casing elevations for all observation wells from the Moanualua Ridge to west of North Halawa Valley be referenced to a consistent elevation datum.

These and additional comments from the Regulatory Agencies on the MWIWP are presented in the enclosed attachment to this letter. In addition, we have attached a copy of the MWIWP comment letter received from the Honolulu Board of Water Supply (May 27, 2016). We reviewed their comments and have incorporated many of them in our own comments.

Our purpose in approving this deliverable in part, rather than disapproving it under AOC Section 7(b)(d), is to allow the Navy to move forward in preparing for the new monitoring well installations. We approve the monitoring well locations, drilling methodology, and well construction details as presented in Sections 3 and 4 but need the Navy and DLA to address the deficiencies stated above and in the attachment before we can fully approve the MWIWP. However, as discussed in our meeting on May 10, 2016 in Honolulu, we are aware that moving forward on the installation of these new wells is of the upmost importance. Therefore we wanted to approve those portions of the MWIWP and trust that this partial approval allows you to begin work as soon as possible.

We are available to discuss our comments in more detail. Please contact us if you have any questions.

Sincerely,

Bob Pallarino
EPA Red Hill Project Coordinator

Steven Chang, P.E.
DOH Red Hill Project Coordinator

Enclosure

cc: Mr. Stephen Turnbull, U.S. Navy

Regulatory Agency Comments on April 29 2016 Monitoring Well Installation Plan, Red Hill Bulk Fuel Storage Facility

Section 1. Background

Section 1.2.1.3 – Geology and Soils, Page 1-5

Lines 34 - 37:

- This paragraph describes the lava beds in the area of Red Hill as "near horizontal". The Regulatory Agencies believe an acknowledgement of potential of these beds to dip is important. This paragraph should end with a sentence stating that characterizing the strike and dip of the lava flows is important for understanding any product migration in the vadose zone outside of the concrete cocoon of the tanks and will be conducted as part of the overall hydrologic investigation required under Sections 6 & 7 of the AOC SOW.

Page 1-6

Lines 1 to 11:

- There is much discussion on soils but an incomplete introduction of basalt (clinkers Aa, Pahoehoe, fractures) (Mark Frazier **[Question for MF from BP: Last 2 paragraphs on page 1-5 seem to address this, is it insufficient?]** (MF: Yes)
- The geology and soils section should include a brief discussion of late stage volcanics, e.g. Salt Lake, Caprock formation and deep stream sediments which could act as barriers to groundwater flow.

Section 1.2.1.4 – Groundwater, Page 1-6

- This section should include a paragraph to explain that perched groundwater is present at many locations in the study area, including the basalt and valley fill units in the Red Hill vicinity. The explanation should include what is known about perched water occurrences at Red Hill. Perched water is common in the Halawa Valley near the area where RHMW11 is proposed. During the drilling of RHMW04 a perched water zone that extended from 85 down to about 130 feet below ground surface. A review of the boring logs for RHMW06 and RHMW07 by the Regulatory Agencies found no mention of perched water, which was surely encountered while drilling these two wells.

Lines 13-17:

- There is some uncertainty as to whether all flow is towards the harbor. The investigation that is beginning with the installation of these monitoring wells will help us understand if there are conditions present in the subsurface that would cause the groundwater to flow in directions other than towards the harbor. The last sentence in the first paragraph (line 17) should make mention of this uncertainty.
- The description of groundwater in this section fails to mention high-level dike confined groundwater.

Lines 25 – 31:

- This paragraph should clarify that while the Caprock aquifer does not extend to the areas in the vicinity of the tanks, it is present in the study area and can influence the flow of groundwater. The Caprock has the potential to divert groundwater flow and other subsurface barriers that may confine flow likely exist within the study area and possibly site area.

Section 1.2.2 – Site History, Page 1-7

Line 37:

- The second paragraph of this section (lines 36-37) refers to the Navy supply well as being downgradient from the USTs. Since the actual downgradient direction in the vicinity of Red Hill has not been adequately defined this sentence should acknowledge the uncertainty, pointing out the importance of this and other

investigations to characterize groundwater flow patterns beneath the foot print of the facility. It would be more accurate to state "the assumed down gradient direction" or similar since at this point since we don't know regional gradient beneath the Facility.

- The blue arrow on the figure entitled "Location Map" (page 21 of the PDF version of the document) is consistent with that shown in USGS publications. However, these publications are based on conceptual models developed decades ago and without the new water level data that has been, and will be acquired by Red Hill investigations. Furthermore, fuel related constituents have been detected in RHMW04 which suggests that at times there is groundwater flow from beneath the Red Hill USTs to the northwest. The arrow should be removed or otherwise modified to reflect the uncertainty.
- The stated distances from USTs to the RHS vary from <2000 to >4000 ft. The distance from the east end of the Red Hill Shaft infiltration gallery to UST 1 is about 1,500 ft, while the distance from west end of the infiltration gallery to UST 20 is about 4,500 ft. Some consistency needs to be used when describing this important parameter. The Regulatory Agencies believe the shortest distance to the infiltration gallery is the greatest concern when considering risk.

Page 1-8

Lines 1 – 7:

- The construction sequence of tanks is not described accurately. Upper domes were constructed first, cavity for tank barrel and bottom blasted and excavated and then barrel and bottom of tank were constructed.

Section 2.1 – Step 1, State the Problem, Page 2-1

Lines 11-17:

- This paragraph should include an acknowledgement of a data gap regarding the potential migration. Potential migration pathways could include migration down within concrete cocoon next to tank and migration from tank to openings in basalt walls. **[Note from BP: I do not agree with this comment. An evaluation of potential contaminant migration pathways is not the problem addressed by this workplan, it is the installation of wells to evaluate the presence of contamination.]**

Section 2.2 – Step 2, Identify Study Objectives, Page 2-1

Lines 19-21:

- This section states that one of the principal objectives of the MWIWP is to investigate the site stratigraphy and matrix physical properties. This implies that the MWIWP is the primary plan for developing the conceptual site model for the Red Hill project. The Regulatory Agencies do not agree with this implied objective. The sentence should be revised to state: "The principal objectives of the work proposed in this WP are to install monitoring wells at four locations (shown on Figure 2), ***collect data from the boring of the wells that can be used to better understand the site stratigraphy and matrix physical properties***, and obtain additional groundwater hydrologic data.

Lines 24 -28:

- Section 2.2 of the MWIWP states that the secondary objective of the MWIWP is to evaluate the nature of petroleum product and constituent chemicals in the soil, if present in the vadose and saturated zones underlying and downgradient of the tanks. It further states that the scope of the sampling and analysis program in the MWIWP is limited to the collection of subsurface **soil**, which will only be conducted if soil is encountered at depths below the bottom of the tanks or if contaminated soil is encountered. The Regulatory Agencies require the Navy and DLA to broaden the scope of their sampling and analysis to include any material that is coarse grained sand or smaller grain size, e.g. clay, sands, and clinker zone sand. Any contaminated material of this type will be sampled and analyzed if it is encountered at

depths below the bottom of the tanks or if contaminated materials of this type are encountered while drilling.

Section 2.5 – Step 5, Develop the Analytical Approach, Page 2-2

Lines 10 – 11:

- See previous comment to sample all coarse grained or smaller sediments with contamination.
- While the Regulatory Agencies assume that all cores will be screened with a photoionization detector (PID) whether below or above the bottom of the tanks, this section should include a bullet stating such.

Lines 12-13:

- The Navy needs to define the term "significant contamination".
- The intention of this statement is not clear. What actions will the Navy propose to take in the event that significant contamination is detected (once "significant" is defined)?

Section 2.6.2 – Managing Decision Error, Page 2-5

Lines 7-8:

- Leveling the drilling well twice a day during drilling is not sufficient to ensure that well is plumb. With groundwater gradients of approximately 1 ft/mi. it is important that a true vertical depth survey be performed since one of the primary products of Task 5 of the Navy's proposed Scope of Work for the Investigation and Remediation of Releases is characterizing the groundwater flow gradient. The Regulatory Agencies recommend the Navy refer to Honolulu Board of Water Supply (HBWS) well construction details for vertical truth of well. According to the HBWS guidance ***"The level of the drill rig is not the only factor important to ensure drilling a "vertical" borehole. Other factors include bottom-hole weight (bottom-hole drill assembly) and rate of advance, which together should be balanced so the drill bit doesn't deflect as it encounters various basaltic intra flow structures. To accurately determine if each borehole is vertical, the driller should stop and trip-out of the hole and run a gyroscopic alignment survey once a day during drilling."***

Section 3-1 – Monitoring Well Locations, Page 3-1

Lines 34- 35:

- The Navy states that "The proposed well locations (Figure 2) were chosen based on their potential to provide more information about the site's geology and groundwater, and to fill in identified data gaps". Please provide a brief description that specifies the data gaps each well location is intended to address. The description can be included in this paragraph or in the paragraphs describing each well location on pages 3-1 and 3-2.

Lines 31-32:

- The text should specify that RHMW11 is intended to provide data to help characterize the geological matrix of ***South*** Halawa Valley.

Figure 3, Geological Cross Section (Transverse)

- What is the basis for the extent of the Valley Fill and Saprolite areas as illustrated in Figure 3? The Navy needs to either provide supporting documentation or references or indicate that the extent of the valley fill depicted on the figure is speculative.
- The description of RHMW11 on page 3-2 states that in order to fully investigate the extent of valley fill or saprolite this well boring may be extended if bedrock is not encountered. Figure 3 should provide an indicator to show the additional depth of RHMW11 in the event that bedrock is not encountered at the target depth.

- Since the facility is the focus of the investigation and RHMW02 is located more or less in the center of the facility, the Regulatory Agencies recommend that the X-axis be centered at RHMW02, which would make it easier to determine lateral distances from the facility.
- The figure incorrectly shows the Halawa Shaft terminating within the valley fill. The Halawa Shaft extends to the basalt underlying the valley fill. The Halawa Shaft is bored into the wall of North Halawa Valley so the depiction of a vertical well located in the center of the valley is inaccurate.

Figure 4, Longitudinal Cross Section

- Delete the word "Geological" from the title of this figure since no geologic features are depicted in this figure.
- The Regulatory Agencies believe the dashed lines representing South Halawa and Moanalua Streams do not correctly represent the gradient or elevation of these waterways. Moanalua Stream is shown at an elevation below the bottom of the tanks which is not correct.

Section 3.2.3 – Rock Coring, Page 3-8

Lines 21-22:

- Checks for perched should occur more frequently. If only checked at the beginning and end of the day it would be easy to drill through a perched zone without knowing it. When potential perching formations are observed in the rock cores (e.g. highly weather basalt, soil, very massive lava, etc.), the borehole should be checked for standing water.

Figure 5, Cross section of Borehole and Monitoring Well

- A description of the filter pack should be included in Figure 5.
- Figure 5 indicates that bentonite chips will be used to seal the annular space between the well casing and the borehole. Due to the depth of the wells and the importance of achieving a continuous seal, the Regulatory Agencies require the use of cement grout to seal the entire annular space rather than dry bentonite chips that will need to be hydrated.

Section 3.3 – Subsurface Soil Sampling, Page 3-11

Lines 2-9

- The term "soil" should be replaced with "sediment". See the Regulatory Agencies' comment on the MWIWP Section 2.2 above.

Section 3.4 – Monitoring Well Installation, Page 3-11

Lines 26-29:

- HDOH TGM (Section 6.2) recommends maximum screen length of 10 ft, with 7 ft below water table surface and 3 ft above. The appendix to the MWIWP also includes a discussion of appropriate screen lengths (page 212 of the PDF, page 16 of 44 of the appendix section entitled "Monitoring Well Installation and Abandonment") stating that screen length should be limited to 5 to 10 feet, however longer intervals may be justified in certain circumstances. This section should include an explanation and rationale for the Navy's choice of a 30 foot screen length.
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Table 3-3, Existing and Anticipated Borehole and Well Dimensions

- Since neither of these wells are screened the Navy should determine and provide the depth of the bottom of the well casing for wells RHMW 2254-01 and HDMW 2253-03 rather than stating "Not Applicable" for the screen interval.

Section 3.5 – Surveying, Page 3-12

Lines 5 – 12:

- The groundwater flow gradient is a regional problem involving the possibility of groundwater flow from the Honolulu Aquifer to the Pearl Harbor Aquifer. This is particularly important as needs consistent elevation datum to wells from Moanaulua Ridge to well west of North Halawa Valley. The TOC elevation of all wells used in the gradient calculations and the model calibration need to be accurately surveyed to a common vertical datum.

Section 4.3.7 – Dedicated Groundwater Pump System Installation, Page 4-7

Lines 18-19:

- At this time it is the Regulatory Agencies belier that any contamination from Red Hill fuel is near the surface of the water table. Installing pump intakes at 10 feet below the water table is too deep and may introduces a sampling bias because at that depth below the water table samples can be diluted by clean water. The Regulatory Agencies require that the pump intakes be placed at 2 to 5 feet below the water table.

Section 4.3.9 – Subsurface Soil Sampling, Page 4-7

Line 32:

- This section states that soil samples will be collected for Chemicals of Potential Concern (COPC) analysis for any soil encountered at depths lower than the tank bottoms or if contaminated soil is encountered. In Section 3.3 it states that soil samples will be collected for COPC analysis for any soil encountered at depths >= 100 ft bgs. This plan needs to have consistent specifications. **(MF: The navy simply states sampling is "discrete and 100 grams". Discrete means to grab from a single spot. 100 grams indicates the volume but no specific sample method, are they using a spoon to fill a jar? Typically, a consultant states encore or similar sampling device then extrude to a preservative w/in a VOA or jar. Then the table they present needs much more than 100 grams to fill.)**

Lines 34-35:

- The plans description of discrete sampling is unclear. Discrete sampling with 100g. Not encore, not MIS, not per their SOP, no field methanol. Later sample table says use a VOA for soil. Need to research more. (Mark Frazier) **[Note from BP: Can you flesh out this comment some more, using complete sentences. I am not familiar with discrete sampling procedures]**

Lines 35-37:

- Revise the sentence beginning on line 35 to read "*The subsurface soil samples will be inspected for evidence of contamination (visual, olfactory, elevated PID readings) in order to evaluate the potential migration of LNAPL and associated constituents.*"

Section 5, Sample Details, Page 5-1

Table 5-1, Subsurface Soil Sample Details for Monitoring Well Installation WP, RHSF

- Replace the word ***soil*** in the Table title with ***sediment.***
- For TPH-g and VOCs, it is unclear why the container type is listed as 40 mL VOA vial. 100g to be collected, no encore sampling method mentioned (encore takes 5 g) yet 40ml VOA? Needs clarification. Seems like a water sample. Ask Randy H for help to pursue/clarify. (Mark Frazier) **[Note from BP: Can you flesh out this comment using complete sentences?]** (MF: The sediment analysis for TPH G and VOC is use a 40 ml VOA. Encore or similar sample device is not mentioned. How is the Navy intending to collect their sample?)

Table 5-2, Geotechnical Sample Details for Monitoring Well Installation WP, RHSF

- The matrix stated in Table 5-2 is "Solid" as opposed to "Soil" in Table 5-1. The Regulatory Agencies assume that "Solid" refers to rock cores, yet the analysis listed is for soil. The purpose and intention of the information presented in Table 5-2 needs to be better described.

Table 5-3, Potable Water Sample Details for Monitoring Well Installation WP, RHSF

- The table does not address the collection of split samples and the use of a silica gel preparation. The table should specify another set of TPH containers. (Mark Frazier) **[Note form BP: Please check that the wording on this comment is correct]** (MF: Needs Randy to comment.)
- If sample is unpreserved it is 7 days and preserved is 14 days. If I am correct, needs to be corrected. Ask Randy H. (Mark Frazier) **[Note from BP: Is this a correct comment?]** (MF: I believe so.)